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INTERRELATION BETWEEN FERTILITY AND NON-ECONOMIC CHARACTERISTICS IN INDIA: RESULTS FROM A LOG-LINEAR MODEL

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ABSTRACT

Total fertility rates by religion, residence, education, age at and duration of marriage are computed for Gujarati women from the special fertility tables of the 1971 Census. The differentials by age at marriage, schooling, residence, and religion are all in the expected direction. A log-linear representation of the fertility data shows that the main effects of religion and residence, and interaction effects are significant. A rank ordering of the models reveals that residence and schooling together explain the data most parsimoniously.

Key Words: Fertility, Non-economic characteristics, log-linear model, Gujarat, India.

Interrelation Between Fertility and Non-Economic Characteristics in India: Results from a Log-Linear Model

1. Introduction

Human fertility is a complex phenomenon. The birth performance of a female is influenced not only by physiological factors, but also by a series of social, economic, cultural and psychological determinants which interact among themselves as well as with the physiological factors. This paper attempts to study the interrelation between fertility and selected non-economic characteristics in Gujarat, India. Some of the characteristics studied are religious affiliation, age at marriage, present age, level of schooling and residence.

Since Davis' (1951) The Population of India and Pakistan, where the sociology of fertility in India has been brought out rather clearly, many a study on fertility has been carried out, resulting in routine reports. Theoretically based meaningful research, however, is rare. Recently Mahdevan (1978) has looked at fertility in Tamil Nadu from a sociological perspective. An earlier piece of research on fertility differentials in central India by Driver (1963) may be pointed out here as well as the United Nations (1961) classic on the population of Mysore. Detailed fertility studies based on census data have been rather meager. This is because one main non-economic but demographically relevant variable, viz religion, is not cross-classified with others (e.g., age, education). There have been, of course, special studies (e.g., on Parsees by Karkal, 1977) done at the time of the 1971 Census. But a major source of information on fertility, collected at the time of the census and presented in the F-series of special tables (India, 1978), does not seem to have been, as far as this author is aware of, fully tapped. These tables

present the distribution o;f "currently married women and the related births" during the year before the census, by education, duration of marriage, age at marriage, present age, religion and residence. We analyze such data in order to assess the fertility dynamics in India.

2. Theoretical Model

2.1 The Framework

As noted earlier, fertilility is influenced by several factors, singly and jointly. There are a number of sociologically relevant frameworks developed by, Davis and Blake (1956), Freedman (1961-62), Hill, Stycos and Back (1959) and Tien (1968). Among the economic models are the ones due to Becker (1960); Easterlin (1969), and Namboodiri (1972). Since non-economic characteristics are considered, the theoretical framework adopted here, is from among the sociological models. And since socio-psychological and demographic factors (e.g., infant mortality) are not available for the analysis, the frameworks of Tien and Hill et al cannot be put to use here. Thus we are left with the Davis-Blake and the Freedman models. As Freedman's framework is centered around norms, it is relevant here. Religious affiliation and social environment lead one to internalize certain norms and values regarding children. At times, as in India, economic necessity is part and parcel of these norms (e.g., the need for begetting a male issue as old age security and to perform funeral rites, etc.). It is easy to see how these norms determine the use of some, or all of the intermediate variables suggested by Davis and Blake. Thus we consider only the Davis-Blake framework to develop our theoretical bases.

A diagrammatic presentation of the model used here is given in Figure 1.

We have "religious affiliation" (a poor indicator of religiosity, or how deeply committed a person is), physiological factor "age", and rural/urban residence (environment) as independent determinants. The environment may

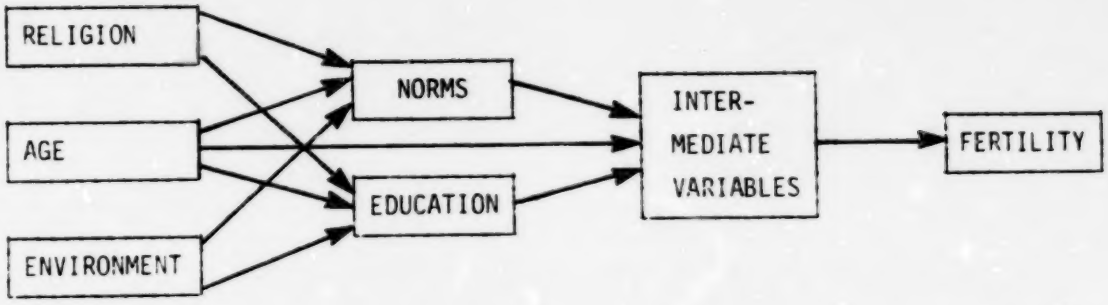

Figure 1. Theoretical Model-Flow Chart

interact with religion. It is seen that in urban areas, the variable religion is less significant than in rural areas. This erosion of faith arises as a result of exposure to modernization and interaction of people drawn from varied backgrounds. Similarly, age and religion interact; the young tend to be less religious.

Between the set of Davis-Blake intermediate variables and "religion", "age", and "environment", we have "norms" and "education". Norms are shaped by "religion" and affected by "age" and "environment". "Education" also is governed by "religion" and "enviornment". Its relationship with "age" also is direct as primary level education, at least, is emphasized in India now. Similar reasoning can be applied to other variables as well. One can control one or more variables at a time. It is also possible to throw in various terms of interaction to make the model comprehensive.

2.2 Previous Research and Findings.

A review of earlier research helps formulate proper relation between fertility and some of the non-economic characteristics. Analysis of 1951 Census data on fertility reveals that, at least for Travancore-Cochin, urban fertility (6.4 children on an average) is lower than the rural one (6.6 children).

There is more information on fertility by religious groupings. Parsees have been known to have the lowest fertility in India, followed by Jains (see Davis, 1951). Majumdar's (1960) Kanpur survey showed that Moslem women, on an average, gave birth to 8.0 children as compared to 7.0 by Hindu women. Driver (1963) found that in Central India, the average number of children by religious groupings was 4.6 (Moslems), and 4.5 (Hindus). A similar pattern nof Hindu-Moslem difference in fertility is observed in the United Nations' Mysore Population Study. The U.N. study also pointed out differentials by level of schooling. It was seen that in Bangalore city, women with less than seven years

of schooling (middle school) had, on an average, 5.3 to 5.5 children, while those who had ten or more years of schooling (high school, or more) had only 3.9 children.

There is more evidence of differential fertility by age at marriage in India. The Mysore survey showed that rural females who married between 14 and 17 years of age had 5.9 children, while those married between 18 and 21 had only 4.7 children. The Kanpur survey found that the average number of children born to women who married at an age less than 15 was 6.9, and 6.0 for those who married after 19. Mukerjee's (1961) Calcutta survey, Balakrishna's study on Madras and Agarwala's survey of villages near Delhi and Lucknow reveal (see Agarwala, 1967, pp. 38-39) that females marrying after age 19 have their fertility reduced by about .5 to 1 child on an average. Jain (see, Agarwala, 1969) has noted that, in rural Punjab, females marrying below 18 had 5.7 children, on an average, as against 5.2 for those married between 18-22 and 4.4 for those married after 23.

Fertillity differentials by caste have been dealt in depth by Davis (1951) and in Khanna study (Wyon and Gordon, 1971). This aspect is not entered into in our analysis. An overview of the major results in Indian differential fertility is available in Jain (1975).

2.3 Some Hypotheses.

From past research on fertility in India and elsewhere, we expect age to be positively correlated with fertility; but age at marriage, education, and residence, negatively related. We also expect Moslems to have the highest and Jains the lowest fertility. The role of the various interaction terms is not easily conjectured. If residence is fixed or controlled, fertility may decline with increase in schooling; the degree of that relationship may be weak in rural and strong in urban areas. Hence we expect education x residence interaction

moderate in strength. Similar arguments yield interactions of the type age x education, age x religion, age x residence, education x religion, residence x religion, religion x age at marriage to be moderate or weak. It is not easy to conjecture the nature of higher order interactions and hence we shall omit them in the statistical analysis.

3. Data

The data are for the State of Gujarat, from the special tables on fertility, collected in the 1971 Census. The results developed for Gujarat, it is hoped, might be reflective of the general nature of such relationships for the country as a whole. In the non-statistical section of the paper, various types of rates have been calculated and analysed. For the statistical model, births in 1970 are cross-classified by a manifold contingency table and analyzed by the log-linear technique.

In the demographic analysis section, Sikhs and Buddhists are omitted, as no reliable measures of fertility can be developed with a small number of cases per cell.

4. Demographic Analysis

We present a simple demographic analysis here in order to elicit differentials in fertility. Since the data are categorized into several classes on the bases of several characteristics simultaneously, mostly standardized measures are shown.

4.1 Rural-Urban and Religious Differentials by Present Age.

In Table 1, total fertillity rates (TFR), based on the age span 13-47 years are shown, for Gujarati women by religious affiliation and residence. The rural-urban diffrential is clear for all religious groups and is in the expected direction. The largest differential is noticed for Hindus and the smallest for Christians. In regard to religious groupings, Moslems have the highest

fertility, and Jains the lowest. The fertility of Hindus and Christians is intermediate to those of Moslems and Jains. The rank order differs slightly, if residence is controlled. In urban Gujarat, the Hindu fertility is the second lowest, followed by the Christian. In the rural parts of the State, Hindus have the second highest fertility.

Using the TFR of all the religious groups together, index numbers are calculated for the four major religious groups considered here and shown in Table 1. A look at the index numbers or the TFRs themselves, reveals that the differentials are in a slightly narrow range in urban than in rural areas. The Jain-Moslem differential is 1,812 per 1,000 women in rural and 1,485 per 1,000 in urban Gujarat. On the other hand, the Hindu-Jain differentials are 1,126 (rural) and 604 (urban) and interestingly enough, the Christian-Jain differentials are 614 (rural) and 1,090 (urban). While for the Hindus and Moslems, the rural to urban change decreases fertility in relation to Jains, for Christians, an increase is noted.

4.2 Rural-Urban and Religious Differentials by Marriage Duration.

Table 2 presents TFR values obtained by standardizing for marriage duration. (30+ years of marriage duration is taken as 30-40 years).[1] WE see again that urban fertility is lower for all religious groups combined and for each of the major groups under consideration here. The largest rural-urban differential is noted for Chirstians and the lowest for Moslems.

Considering the religious groups again, we see that the lowest fertility is for Jains and the highest for Moslems. In rural Gujarat, the fertility differences among Hindus, Moslems and Christians are, indeed, small. The Jains stand out as a separate group in this regard. In urban Gujarat, the differences are rather marked (Hindu-Moslem 633, in favor of Moslems; Hindu-Christian 662, in favor of Hindus; Hindu-Jain 1,280, in favor of Hindus; Moslem-Christian

TABLE 1

TOTAL FERTILITY BY RELIGION AND RESIDENCE GUJARAT, 1970

Residence	Religion				
	Hindu	Moslem	Christian	Jain	All religions
Rural	5,988	6,674	5,476	4,862	6,007
(Index Nos.)	(99.7)	(111.1)	(91.2)	(80.9)	(100)
Urban	4,899	5,780	5,389	4,295	5,007
(Index Nos.)	(97.8)	(115.4)	(107.6)	(85.8)	(100)

SOURCE: Computed from Census data.

TABLE 2

MARRIAGE DURATION STANDARDIZED FERTILITY RATE BY RELIGION AND RESIDENCE, GUJARAT, 1970

Residence	Religion				
	Hindu	Moslem	Christian	Jain	All religions
Urban	5,204	5,837	4,542	3,924	5,255
(Index Nos.)	(99.0)	(111.1)	(86.4)	(74.7)	(100)
Rural	6,153	6,503	6,026	5,249	6,161
(Index Nos.)	(99.9)	(105.6)	(97.8)	(85.2)	(100)

SOURCE: Computed from Census data.

1,285, in favor of Moslems; Moslem-Jain 1,913, in favor of Moslems; Christian-Jain 618, in favor of Christians). We may note, then, that in the urban environment, fertility differentials are quite conspicuous among the religious groups.

4.3 Rural-Urban and Religious Differentials by Age at Marriage.

Total fertility-like measures[2] are computed by age at marriage (28+ group is taken as 10 years in length) for all the major groups and Gujarat as a whole and index numbers for such measures are shown in Table 3. Here also, the rural-urban differential is in the expected direction. As far as the differences in fertility by religious affiliation are concerned, the lowest and the highest levels are noticed for Jains and Moslems. The urban Christians have lower fertility than urban Hindus (the differential is rather negligible), while the rural Hindus have lower fertility than their Christian counterpart (differential not insignificant).

From the above, we conclude that the rural to urban shift produces a change in the direction of religious differentials as far as Hindus and Christians are concerned.

4.4 Fertility Differentials by Religion, Residence and Education.

In Table 4 are shown TFRs for rural and urban Gujarat by religious grouping and level of schooling. As one moves from education group 1 to group 4, the level of schooling increases.

In general, for all religious groups, urban and rural, it is seen that fertility and schooling are negatively related. For urban Christians and Jains, a slight curvilinearity is observed, when the fertility of educational groups is looked at in a continuum. The general pattern in regard to religious differentials, when schooling and residence are controlled, is as follows. In urban areas, for those with higher levels of schooling (high school and above),

TABLE 3

INDEX NUMBERS OF FERTILITY RATES STANDARDIZED FOR AGE AT MARRIAGE BY RELIGION AND RESIDENCE
GUJARAT, 1970

Religion	Rural	Urban
Hindu.	99.3	98.6
Moslem	118.5	114.3
Christian	104.8	97.2
Jain	93.6	87.4
All religions	100	100

SOURCE: Computed from Census data.

TABLE 4

TOTAL FERTILITY BY RELIGION, RESIDENCE, AND EDUCATION, GUJARAT 1970

Residence		Religion			
		Hindu	Moslem	Christian	Jain
Urban					
Education	Group 1	5,427	6,003	3,192	4,403
	Group 2	4,364	5,348	4,773	4,452
	Group 3	3,864	4,214	4,649	3,882
	Group 4	3,490	NA	NA	3,865
Rural					
Education	Group 1	6,149	6,680	5,533	5,127
	Group 2	4,955	6,560	5,344	4,938
	Group 3	4,558	NA	NA	NA
	Group 4	3,135	NA	NA	NA

Source: Computed from Census data.

(Legend: Group 1 - Illiterate, Group 2 - Liberate but less than Matriculate, Group 3 - Matriculate and above but less than Graduate, Group 4 - Graduate and above).

the Hindus have the lowest fertility, followed by Jains, Moslems and Christians in that order. For urbanites with some schooling (less than high school), the Hindus still have the lowest, the Jains the second lowest, the Christians the third, and the Moslems the highest fertility. Among the illiterate urbanites of Gujarat, the Christians seem to have the lowest fertility, followed by Jains, Hindus and Moslems.

In rural Gujarat, the pattern, regardless of schooling, is: the Jains exhibit the lowest fertility and the Moslems, the highest birth performance. Among illiterates, the Christians have lower fertility than Hindus. But for those with a little schooling (less than high school), the Hindu women have less number of children than Christians.

It may be concluded, therefore, that education affects fertility in such a manner as to change the general pattern obtained by looking at one or two characteristics alone.

4.5 Influence of Education on Fertility through Age at Marriage.

Education influences fertility in more than one way. It helps create the awareness of birth control measures, thus directly affecting fertility. Also, it modifies the age at marriage, and the exposure to sexual unions. As the institution of marriage is still strong in India, the higher the age at marriage, which is positively linked to schooling, the lower the fertility. This may not be true, where education is religion-based, as is the case for Catholics. In general, education in India is secular, and therefore, we do not expect any relationship to the contrary.

Treating the women who gave birth to in 1970 as a sample, the mean and the median age at marriage may be computed. These are shown in Table 5 by religion, education, and residence. The following pattern is noted:

TABLE 5

MEDIAN (M) AND MEAN ($\bar{X}$) AGE AT MARRIAGE BY RELIGION, RESIDENCE AND EDUCATION, GUJARAT, 1970

Residence		Hindu		Moslem		Christian		Jain	
		M	$\bar{X}$	M	$\bar{X}$	M	$\bar{X}$	M	$\bar{X}$
Urban									
Education	Group 1	16.5	17.0	17.9	19.1	17.6	18.6	17.2	18.0
	Group 2	17.3	18.1	18.8	17.9	19.7	19.3	18.2	17.0
	Group 3	20.0	19.8	20.3	20.2	21.5	22.0	20.6	20.6
	Group 4	22.1	22.9	22.2	23.0	24.9	24.5	22.9	24.2
	Overall	18.7	19.5	19.6	20.1	20.6	21.1	19.4	20.0
Rural									
Education	Group 1	16.6	17.1	17.9	16.7	17.1	18.0	16.7	17.3
	Group 2	16.7	17.3	18.4	17.4	18.0	16.8	17.6	18.7
	Group 3	19.6	19.2	20.2	20.1	20.4	20.3	19.8	19.4
	Group 4	21.5	22.0	NA	NA	NA	NA	NA	NA
	Overall	16.7	17.9	18.4	18.1	18.0	18.4	17.6	18.5

SOURCE: Computed from Census data.

(Legend: Group 1 - Illiterate, Group 2 - Literate but less than Matriculate, Group 3 - Matriculate and above but less than Graduate, Group 4 - Graduate and above.

a) The mean age at mariage increases as the level of schooling increases, irrespective of religion and/or residence.

b) Christians have the highest mean age at marriage and Hindus, the lowest, flanking the Jains and the Moslems.

c) The mean age at marriage is higher in the urban, compared to the rural areas.

Similar to these are the differentials in fertility, as corroborated by the findings in section 4.4.

4.6 Fertility by Age at Marriage, Religion, and Education.

Table 6 is complementary to Tables 4 and 3 showing total fertility (hence standardized for the present age distribution) by religion, age at marriage, education and residence. Owing to paucity of data, only two education groups are shown. The differentials by religion, residence, and education with one or two characteristics at a time are in the expected direction. Age at marriage brings in a curvilinearity to the relationship. Those married between 13-17 years of age have higher fertility than those married at other ages.

This is true whichever group one is considering, with one, two, or three characteristics controlled. Curvilinearity may arise from physiological (sub-fecundity in those that marry before 13), and sociological (non-exposure to sexual union due to strict social control) factors.

5. Log-Linear Model.

A log-linear analysis[3] is developed to obtain a description of the relationship between the factors of the table (indicated by the variables used) either by forming a model for the data, or by testing and ordering the interactions between factors.

TABLE 6

TOTAL FERTILITY BY AGE AT MARRIAGE, RELIGION, RESIDENCE, AND EDUCATION, GUJARAT 1970

		Hindu		Moslem		Christian		Jain	
Residence	Age at Marriage	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Urban	Less than 13	5,274	4,339	5,956	5,810	NA	NA	NA	NA
	13 - 17	5,741	4,432	6,291	5,528	3,582	4,571	4,571	4,476
	18 - 22	5,433	4,415	5,815	5,279	1,349	4,705	4,705	4,299
	23 - 27	4,027	3,613	4,662	4,286	NA	NA	NA	2,861
	28 +	2,634	2,280	3,621	2,011	NA	NA	NA	NA
Rural	Less than 13	5,914	4,831	5,876	5,903	5,122	4,745	NA	NA
	13 - 17	6,165	4,980	6,810	6,327	5,022	6,411	5,984	5,350
	18 - 22	5,949	4,966	6,291	6,367	6,724	5,204	4,398	4,498
	23 - 27	4,623	3,325	5,216	6,937	NA	NA	NA	NA
	28 +	972	1,693	4,459	NA	NA	NA	NA	NA

SOURCE: Computed from Census data.

5.1 A Simple Model.

This is an unconventional approach to model building.[4] But our objective is to look for patterns in the data. The TFR values of rural and urban Gujarat by religious and educational groupings are considered (see Table 4). The variables used are R – religion (four levels), E – education (two levels), and U – residence (two levels). The frequencies in each cell are the number of births per 100 women standardized for age distribution. The census data, it is assumed for purposes of statistical analysis, are a sample drawn from a super population.

First we fit the saturated model to obtain the following (after necessary iterations):

Effect	Degrees of Fredom	Probability
R	3	0.0000
E	1	0.3317
U	1	0.0000
RE	3	0.0001
RU	3	0.0164
EU	1	0.0055
EUR	3	0.0002

From the fit, we see that main effect E is not significant, whereas all others, including the third order interaction, are. Therefore, we omit E in further analysis, even though most of what we know in demographic literature goes against this finding.

Next, we fit the model (UR). It is found to be significant. The models (UE), (RE), (UR, UE), and (RE, UR, UE) are all significant as well. Since the probability values are all close to zero, and less than the probability parameter (–, .05), the lambda parameters are not computed by the program.

We can rank order the various models on the basis of the size of the Likelihood Ratio Chi Square, or the Pearson Chi Square. These are given on the following page.

Model	L.R. Chi Square	Pearson Chi Square
Saturated	0	0
(UR, RE, UE)	19.60	19.56
(UR, RE)	27.30	27.22
(UR)	49.35	49.12
(RE)	119.30	118.39
(UE)	155.07	156.27

The parsimonious model seems to be (UE) - i.e. residence and education together determine the fertility levels of the population groups considered here.

6. Discussion and Conclusion.

We have presented here results from a demographic and a statisical analysis of data on human fertility in Gujarat. And we find that the fertility differentials by religion, education, and residence are in the expected direction. Surprisingly, education factor does not appear to be statistically significant, even though substantively those women with lower levels of schooling had higher birth performance. It may be mentioned that in the analysis the top levels of schooling (high school and above) were omitted as the TFRs could not be satisfactorily computed. We presume that, if these groups were included, the education variable would have been significant.

Although education is not, religion, residence and the various interactions are statistically significant and hence sociologically meaningful. In fact, the best model to explain the data is seen as (UE) - residence, education and their interaction. Religion does not seem to carry much weight at all. This leads one to conclude that modernization elements flowing through education and residence are most influential in determining the levels of fertility of this population. Further analysis with data on age at marriage, income, use of contraception, participation in labor force, etc., might bring out the fertility dynamics in Gujarat and therefore in India, better and clearer.

7. Acknowledgments.

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END NOTES

1. It is presumed that the data refer to currently married women and that the fertility referred to here is marital fertility. For Indian society, such an assumption seems reasonable.

2. These TFR like quantities are computed exactly like the TFR. Specific rates by age at marriage are multiplied by the appropriate lengths of age intervals and summed. These TFR like values will not equal the conventional TFR values obtained from age specific fertility rates.

3. For a good overview of log-linear analysis, see Fienberg (1980). The BMDP and the new SPSS packages have also good write-ups on this methodology. The BMDP program has been used here for computation.

4. A more detailed log-linear model is presented in Appendix 1.

APPENDIX 1

Findings from a more detailed log-linear model

The results of a more detailed analysis are highlighted here. Instead of TFR values, births experienced a year before the Census are analysed here for Gujarat. The variables are: A – age, M – age at first marriage, E – education, R – religion, U – residence.

A falls into three categories – 13–22 years, 23–37, and 38+. M is Trichotomous – less than 13 years, 13–22, and 23+. E is dichotomous – illiterate and others. U is also dichotomous – rural and urban. Finally R has four categories – Hindus, Moslems, Christians, and others.

Since second and higher order interactions are not easily interpretable, we shall not fit models involving higher order interactions.

First we fit (A, M, E, U, R). Then we add first order interaction terms to the above. The program picked (A, M, E. UR) as the best. Now let us delete one, or more main effects and ask the computer to select the best. The best model after such deletions was seen as (A, M, E, U). The model (AM, AE, AU, AR, ME, MU, MR, EU, ER, UR) was fit and after deletions, the most parsimonious model turned out to be (AM, AE, AU, AR, ME, MU, MR, EU, ER). Other models, by adding, or deleting third and higher order interactions, have been tried but are not reported here.

We can make some sociological sense of these statistical manipulations. From the various "best models" involving main effects and first order interactions, we see that religion as such is not an important factor in Indian fertility. Factors such as age at marriage, education, residence and its interaction with religion have greater significance in determining fertility differences.

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